

## CLAIMS

1. A program execution control device for causing a processor to execute a program composed of one or more sets of bytecodes including a bytecode for invoking a bytecode set, comprising:
  - a judging unit operable, for each execution of an invocation bytecode during execution of the program, to judge whether a bytecode set targeted for invocation is already compiled to native code specific to the processor;
  - 10 a first unit operable, when the target bytecode set is judged to be uncompiled, to instruct the processor so that the target bytecode set is sequentially interpreted and executed, and to issue a request to compile the target bytecode set to native code;
  - 15 a second unit operable, when the target bytecode set is judged to be compiled, to instruct the processor to execute native code resulting from the compilation; and
  - a third unit operable to instruct the processor to compile a bytecode set indicated by a compilation request issued by said first unit, in parallel with the bytecode interpretation and execution by said first unit as well as with the native code execution by said second unit.
2. The program execution control device according to Claim 1,  
25 wherein  
said program execution control device operates under control of a multitask operating system,  
the compilation by said third unit is executed as a separate

task from the bytecode execution by said first unit and the native code execution by said second unit, and

the tasks of said first and second units are assigned a higher priority level than a priority level assigned to the task of said third unit.

3. The program execution control device according to Claim 2, further comprising:

a switching unit operable to switch to task execution by said third unit when task execution by said first or second unit is placed in a standby state.

4. The program execution control device according to Claim 3, further comprising:

a request management unit operable to register compilation request information in a storage unit in response to a compilation request issued by said first unit and manage the registered compilation request information, each piece of compilation request information being used for compiling a bytecode set indicated by a corresponding compilation request, wherein

said third unit instructs the processor to compile each bytecode set indicated by compilation request information registered in the storage unit, in parallel with the bytecode interpretation and execution by said first unit as well as with the native code execution by said second unit.

5. The program execution control device according to Claim 4, wherein

said request management unit places pieces of compilation request information in a queue in an order in which corresponding compilation requests are received, and

said third unit instructs the processor to compile bytecode sets in order starting from a bytecode set indicated by a first piece of queued compilation request information.

6. The program execution control device according to Claim 4, wherein

said request management unit does not register compilation request information in duplicate, if compilation request information for a bytecode set indicated by a compilation request is already registered in the storing unit.

7. The program execution control device according to Claim 4, further comprising:

a priority information acquiring unit operable to acquire information showing a priority level of each bytecode set, wherein

said request management unit includes:

a specifying subunit operable, in response to a compilation request issued by said first unit, to specify with reference to the acquired priority information a priority level of a bytecode set indicated by the compilation request;

a comparing subunit operable to compare the specified priority level with a priority level of each bytecode set indicated by queued compilation request information in the storage unit; and

a determining subunit operable to determine a position  
for placing a new piece of compilation request information for  
the bytecode set indicated by the compilation request, so that  
the registered pieces of compilation request information are  
5 queued in descending order of priority.

8. The program execution control device according to Claim 4,  
further comprising:

a relational information acquiring unit operable to acquire  
10 relational information showing each bytecode set together with  
all bytecode sets related to the bytecode set; and

a detecting unit operable to detect, with reference to the  
relational information, any bytecode set related to the bytecode  
set indicated by the compilation request, wherein

15 said request management unit registers compilation request  
information for the related bytecode set detected by said  
detecting unit.

9. The program execution control device according to claim 4,  
20 further comprising:

a priority information acquiring unit operable to acquire  
information showing a priority level of each bytecode set;  
wherein

with reference to the acquired priority information, said  
25 third unit instructs the processor to compile bytecode sets  
indicated by pieces of compilation request information  
registered in the storage unit, in descending order of priority.

10. The program execution control device according to Claim 4,  
further comprising:

a count recording unit operable to keep a count of  
compilation requests made to a respective bytecode set when  
5 compilation of the bytecode set is repeatedly requested, and  
records the request count to the storage unit as part of  
compilation request information for the bytecode set; and

an acquiring unit operable to acquire a threshold of request  
count, wherein

10 said third unit instructs the processor to compile bytecode  
sets in order in which respective requests counts exceed the  
threshold.

11. The program execution control device according to Claim 5,  
15 further comprising:

a count recording unit operable to keep a count of  
compilation requests made to a respective bytecode set when  
compilation of the bytecode set is repeatedly requested, and  
records the request count to the storage unit as part of  
20 compilation request information for the bytecode set; and

an order altering unit operable to compare the respective  
request counts and alter positions of pieces of queued  
compilation request information in descending order of request  
count.

25 12. The program execution control device according to Claim 5,  
wherein

said request management unit manages a plurality of queues

with different priority levels, and

5       said third unit instructs the processor to compile bytecode sets in order starting from bytecode sets indicated by compilation request information placed in a highest priority queue.

13. The program execution control device according to Claim 12, further comprising:

10       a special request information acquiring unit operable to acquire, prior to execution of the program, information showing a plurality of bytecode sets requested to be compiled, wherein said request management unit registers, in a batch, compilation request information for all bytecode sets shown by the special request information, in a highest priority queue.

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14. The program execution control device according to Claim 1, further comprising:

20       a second judging unit operable, when said judging unit judges that the target bytecode set is uncompiled, to judge whether the target bytecode set is currently under compilation; and

25       a fourth unit operable, when the target bytecode set is judged to be currently under compilation, to wait until the compilation is done and to subsequently instruct the processor to execute native code resulting from the compilation.

15. The program execution control device according to Claim 1, further comprising:

a request management unit operable to register compilation request information in a storage unit in response to a compilation request issued by said first unit and manage the registered compilation request information, each piece of compilation request information being used for compiling a bytecode set indicated by a corresponding compilation request, wherein

said third unit instructs the processor to compile each bytecode set indicated by compilation request information registered in the storage unit, in parallel with the bytecode interpretation and execution by said first unit as well as with the native code execution by said second unit.

16. The program execution control device according to Claim 2, further comprising:

a priority information acquiring unit operable to acquire information showing a priority level of each bytecode set;

a comparing unit operable to compare priority levels of the bytecode set targeted for the compilation and of the instruction execution task; and

a priority altering unit operable to temporarily raises a priority level of the compilation task, when the comparison shows that the priority level of the bytecode set is higher than the priority level of the instruction execution task.

17. The program execution control device according to Claim 2, further comprising:

a request management unit operable to register compilation request information in a storage unit in response to a compilation

request issued by said first unit and manage the registered compilation request information, each piece of compilation request information being used for compiling a bytecode set indicated by a corresponding compilation request, wherein

5       said third unit instructs the processor to compile each bytecode set indicated by compilation request information registered in the storage unit, in parallel with the bytecode interpretation and execution by said first unit as well as with the native code execution by said second unit.

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18. A program execution control method for causing a processor to execute a program composed of one or more sets of bytecodes including a bytecode for invoking a bytecode set, comprising:

15       a judging step, for each execution of an invocation bytecode during execution of the program, of judging whether a bytecode set targeted for invocation is already compiled to native code specific to the processor;

20       a first step, when the target bytecode set is judged to be uncompiled, of instructing the processor so that the target bytecode set is sequentially interpreted and executed, and of issuing a request to compile the target bytecode set to native code;

25       a second step, when the target bytecode set is judged to be compiled, of instructing the processor to execute native code resulting from the compilation; and

      a third step of instructing the processor to compile a bytecode set indicated by a compilation request issued in said first step, in parallel with the bytecode interpretation and



execution in said first step as well as with the native code execution in said second step.

19. A control program for causing a processor to execute another  
5 program composed of one or more sets of bytecodes including a  
bytecode for invoking a bytecode set, comprising:

a judging step, for each execution of an invocation bytecode  
during execution of the program, of judging whether a bytecode  
set targeted for invocation is already compiled to native code  
10 specific to the processor;

a first step, when the target bytecode set is judged to  
be uncompiled, of instructing the processor so that the target  
bytecode set is sequentially interpreted and executed, and of  
issuing a request to compile the target bytecode set to native  
15 code;

a second step, when the target bytecode set is judged to  
be compiled, of instructing the processor to execute native code  
resulting from the compilation; and

a third step of instructing the processor to compile a  
20 bytecode set indicated by a compilation request issued in said  
first step, in parallel with the bytecode interpretation and  
execution in said first step as well as with the native code  
execution in said second step.

20. A recording medium storing a control program for causing  
25 a processor to execute another program composed of one or more  
sets of bytecodes including a bytecode for invoking a bytecode  
set, said control program comprising:.

a judging step, for each execution of an invocation bytecode during execution of the program, of judging whether a bytecode set targeted for invocation is already compiled to native code specific to the processor;

5       a first step, when the target bytecode set is judged to be uncompiled, of instructing the processor so that the target bytecode set is sequentially interpreted and executed, and of issuing a request to compile the target bytecode set to native code;

10       a second step, when the target bytecode set is judged to be compiled, of instructing the processor to execute native code resulting from the compilation; and

15       a third step of instructing the processor to compile a bytecode set indicated by a compilation request issued in said first step, in parallel with the bytecode interpretation and execution in said first step as well as with the native code execution in said second step.